PATENT
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Confirmation No. 4199
Aki TOMITA	Examiner: Unassigned
Application No.: 10/797,650	Technology Center/Art Unit: 2181
Filed: March 9, 2004	PRELIMINARY AMENDMENT
For: DATA I/O SYSTEM USING A PLURALITY OF MIRROR VOLUMES	
Customer No.: 20350	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

April 27, 2005

Sir:

Prior to examination of the above-referenced application, please enter the following amendments and remarks:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 7 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1. (currently amended) A data I/O system comprising:

a plurality of storage devices; and

a controller which controls said storage devices, wherein said controller includes:

a read/write unit, responsive to the subsequent receipt of a read request and a write request, for reading data stored in said storage devices and writing data in said storage devices;

a logical volume management unit [[for mapping]] configured to map between a logical image of the data storage of a host processor (logical volume) and an actual space in said storage devices;

a volume management unit [[for managing]] configured to manage an active primary production volume (P-VOL) and second multiple mirror volumes (S-VOL) created as mirror images of said primary volume; and

an S-VOL restoring unit [[for restoring]] configured to restore the data of a first S-VOL with the data of a second S-VOL depending on the type of an error that happens in the first S-VOL.

2. (currently amended) A data I/O system according to claim 1,

wherein said controller further includes an access management unit [[for rendering]] configured to render at least one of said S-VOLs read-only,

wherein said S-VOL restoring unit recovers an S-VOL where an error has happened by copying data of the Read-only (RO) S-VOL to said S-VOL.

3. (currently amended) A data I/O system according to claim 1,

wherein said controller includes an access management unit [[for rendering]] configured to render at least one of said S-VOLs read-only,

wherein said S-VOL restoring unit recovers an S-VOL where a drive error has happened by replacing [[it]] the S-VOL with said RO S-VOL.

4. (currently amended) A data I/O system according to claim 1,

wherein said controller further includes:

an access management unit [[for rendering]] configured to render at least one of said S-VOLs read-only; and

a monitoring unit [[for monitoring]] configured to monitor frequencies of accesses to RO S-VOLs,

wherein said S-VOL restoring unit restores the data of an S-VOL where an error has happened by copying the data of an S-VOL with the lowest access frequency.

5. (currently amended) A data I/O system according to claim 1,

wherein said controller further includes:

an access management unit [[for rendering]] configured to render at least one of said S-VOLs read-only; and

a monitoring unit [[for monitoring]] configured to monitor frequencies of accesses to the RO S-VOLs,

wherein said S-VOL restoring unit recovers an S-VOL where a hardware error has happened by replacing [[it]] the S-VOL with a RO S-VOL with the lowest access frequency.

6. (currently amended) A data I/O system according to claim 1,

wherein said controller further includes:

an access management unit [[for rendering]] configured to render at least one of said S-VOLs read-only and rendering at least one of said S-VOLs read-and-writable; and

an increments management unit [[for storing]] configured to store updates that have occurred in a Read-and-Writable (RW) S-VOL since a P-VOL and the RW S-VOL were separated in an increments-volume,

wherein said S-VOL restoring unit recovers a RW S-VOL where an error has happened by replacing [[it]] the RW S-VOL with the RO S-VOL that has been updated by data of the increments-volume of the RW S-VOL.

7. (currently amended) A data I/O system according to claim 1,

wherein said controller further includes:

an access management unit [[for rendering]] configured to render at least one of said S-VOLs read-only and rendering at least one of said S-VOLs read-and-writable;

a monitoring unit [[for monitoring]] configured to monitor frequencies accesses to the RO S-VOLs; and

an increments management unit [[for storing]] configured to store updates that have occurred in a RW S-VOL since a P-VOL and the RW S-VOL were separated in an increments-volume,

wherein said S-VOL restoring unit recovers a RW S-VOL where an error has happened by replacing [[it]] the RW S-VOL with the RO S-VOL with the lowest access frequency that has updated by data of the increments-volume of the RW S-VOL.

8. (currently amended) A data I/O system according to claim 7,

wherein said controller further includes a spare SVOL management unit [[for managing]] configured to manage a spare S-VOL to which read/write accesses are forbidden,

wherein said S-VOL restoring unit recovers an S-VOL where an error has happened by using said spare S-VOL instead of said RO S-VOL.

9. (original) A data I/O system according to claim 7 further comprising a plurality of the storage devices,

wherein said S-VOL restoring unit replaces a storage device where a hardware error has happened and forms an S-VOL with another hardware device.

10. (original) A data I/O system according to claim 8 further comprising a plurality of the storage devices,

wherein said S-VOL restoring unit replaces a storage device where a hardware error has happened and forms an S-VOL with another hardware device.

11. (original) A data I/O system according to claim 1,

wherein said storage devices are disk drives,

wherein said controller further includes a communication adapter communicating with a data processing system issuing read and write requests.

12. (currently amended) A method of controlling a data I/O system which includes:

a plurality of storage devices;

a read/write unit, responsive to the subsequent receipt of a read request and a write request, for reading data stored in said storage devices and writing data in said storage devices; and

a logical volume management unit [[for mapping]] configured to map between a logical image of the data storage of a host processor (logical volume) and an actual space in said storage devices;

said method comprising [[the steps of]]:

managing an active primary production volume (PVOL) and second multiple mirror volumes (S-VOL) created as mirror images of said primary volume; and

restoring the data of a first S-VOL with the data of a second S-VOL depending on the type of an error that happens in the first S-VOL.

13. (new) A method according to claim 12, further comprising:

rendering at least one of said S-VOLs read-only,

recovering an S-VOL where an error has happened by copying data of the Read-only (RO) S-VOL to said S-VOL.

14. (new) A method according to claim 12, further comprising:

rendering at least one of said S-VOLs read-only,

recovering an S-VOL where a drive error has happened by replacing the S-VOL with said RO S-VOL.

15. (new) A method according to claim 1, further comprising:

rendering at least one of said S-VOLs read-only; and

monitoring frequencies of accesses to RO S-VOLs,

restoring the data of an S-VOL where an error has happened by copying the data of an S-VOL with the lowest access frequency.

16. (new) A method according to claim 1, further comprising:

rendering at least one of said S-VOLs read-only; and

monitoring frequencies of accesses to the RO S-VOLs,

recovering an S-VOL where a hardware error has happened by replacing [[it]] S-VOL with a RO S-VOL with the lowest access frequency.

17. (new) A method according to claim 1, further comprising:

rendering at least one of said S-VOLs read-only and rendering at least one of said S-VOLs read-and-writable; and

storing updates that have occurred in a Read-and-Writable (RW) S-VOL since a P-VOL and the RW S-VOL were separated in an increments-volume,

recovering a RW S-VOL where an error has happened by replacing the SW S-VOL with the RO S-VOL that has been updated by data of the increments-volume of the RW S-VOL.

18. (new) A method according to claim 1, further comprising:

rendering at least one of said S-VOLs read-only and rendering at least one of said S-VOLs read-and-writable;

monitoring frequencies accesses to the RO S-VOLs; and

storing updates that have occurred in a RW S-VOL since a P-VOL and the RW S-VOL were separated in an increments-volume,

recovering a RW S-VOL where an error has happened by replacing the RW S-VOL with the RO S-VOL with the lowest access frequency that has updated by data of the increments-volume of the RW S-VOL.

19. (new) A method according to claim 18, further comprising:

managing a spare S-VOL to which read/write accesses are forbidden,

recovering an S-VOL where an error has happened by using said spare S-VOL instead of said RO S-VOL.

20. (new) A method according to claim 18, further comprising:

replacing a storage device where a hardware error has happened and forms an S-VOL with another hardware device.